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ABSTRACT

This is one of a series of 14 instructional components of a semester-long, environmental earth science course developed for undergraduate students. The course includes lectures, discussion sessions, and individual learning carrel lessons. Presented are the study guide and script for a learning carrel lesson on pollution of the oceans. The slides, audio-cassette tape, and other materials necessary for this lesson are not included. (BT)

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Final Report

4 of 16 parts



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GY-9335 (E2)

STUDY GUIDE AND SCRIPT

SECTION V: OCEANOGRAPHY

LESSON 6.15: POLLUTION OF THE OCEANS

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
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ENVIRONMENTAL STUDIES

A Cooperative Project of The Department of Geological Sciences
and the Science Education Center

The University of Texas at Austin

ENVIRONMENTAL EARTH SCIENCE

"Environmental Earth Science" is a new course developed at The University of Texas at Austin by the Department of Geological Sciences and the Science Education Center. It is offered at The University of Texas at Austin as Geology 361K and has been tried out during the spring semesters of 1972, 1973, 1974, and 1975. Revisions have been made as necessary after each tryout. The project within which the course has been developed has been supported by the National Science Foundation.

The course includes lectures, discussion sessions, and individualized Learning Carrel Lessons. Extensive use has been made of multi-media technology in the presentation of the course. Learning Carrels for individualized instruction have been especially designed for this program. The lectures introduce specific topics, suggest problems or questions, and provide background information. The discussion sessions provide the student an opportunity to ask questions and clarify ideas. The discussion sessions also provide input and feedback to the instructor.

The Learning Carrel Lessons have been written by faculty and graduate students in the geological sciences and in science education. Writers and resource contributors include Dr. Robert Boyer, Dr. Rolland Bartholomew, Dr. Keith Young, Dr. Samuel Ellison, Dr. James Underwood, Dr. David Butts, Dr. Addison E. Lee, David Keller, Melanie Lewis, Wayne Schade, Ann Lee, and William McLoda. Technicians involved in production of scripts, sound, and photography were Stan Prescott, Lee West, Charles Geffen, and William McLoda. Artists were Jesus Rivas, Alice Canestaro, Aly Knox, and Javier Flores.

Each Learning Carrel Lesson consists of a set of 2 x 2 slides, an audio cassette tape, a study guide, a script, and other materials necessary to the lesson. The study guide and script are in this booklet. Students may set their own time schedule within an announced period when slides and tapes are made available.

The student should note the list of Learning Carrel Lesson topics to place in proper content the lesson in this booklet, and then read carefully the introduction, rationale, prerequisites, and lesson objectives in the study guide. The student should follow the instructions in the study guide for the entire lesson. In some instances, these instructions are also repeated on the audio cassette tape. The slides and tapes have been synchronized to automatically advance the slides appropriate to the audiotape. However, there is a tone signal given before the change of each slide so that the lesson can be used outside of the carrel if automatic facilities are not available. When the student is ready to start the lesson, the "on" switch should be pushed. If the slides and tape are operated manually, both will need to be turned "on." The first slide is always a title slide or a blank solid colored slide. If

the slides and tape are manually operated, this title or blank slide should be on view before the tape is started. For automatic operation, the slides and tapes will be set up by the Instructor or Proctor before the lesson and between each use. It is most important to start each lesson according to these instructions in order to provide synchronization of the slides and tape. Remember that slides placed in the tray to be used with a rear view screen are reversed from those to be used with a front view screen.

The student will be instructed by the study guide and/or the tape to stop at various places to carry out certain activities. Usually the audio-tape will say, "Please stop the tape now and restart only when you have finished this exercise." Therefore, the student should wait a few seconds to finish hearing the instruction after the word "Stop." However, one should not wait long enough for the tone signal or automatic change to the next slide. This signal should be heard after you restart the tape. If the lesson is moving too rapidly, the student may stop the tape and slides at any time to consult the study guide or script, but it is NOT POSSIBLE to back up and re-examine a given slide without completing the entire cycle of the lesson.

It is particularly important for the student to carry out the instructions for activities given in the study guide. In order that a record may be maintained of these activities, each student should pick up a copy of the STUDENT RESPONSE SHEET which include questions to be answered and the other activities requiring responses. These should be completed and turned in to the instructor as required for grading, feedback for the instructor, and to provide a basis for student interaction in the discussion group.

Each Learning Carrel Lesson is independent within the context of the course. Some of them provide direct information on a given topic, but in an individualized mode requiring some activities and thought on the part of the student. Others place the student in a role-playing situation where some position must be taken on provocative questions or issues. Others deal primarily with applications of environmental information. In all the lessons, the student is expected to receive basic information that is coordinated with the lectures, the small group discussions, and the readings.

ENVIRONMENTAL EARTH SCIENCE

LEARNING CARREL LESSONS

Section I: Man's Effect on Nature

- Lesson 6.1: Population
- Lesson 6.2: Land Use
- Lesson 6.3: Urban Crisis (Field Trip)

Section II: Energy

- Lesson 6.4: Energy
- Lesson 6.5: Energy Resources
- Lesson 6.6: Future Projections

Section III: Processes Through Time

- Lesson 6.7: Geologic Time
- Lesson 6.8: Long Term Events
- Lesson 6.9: Short Term Events

Section IV: Natural Resources

- Lesson 6.10: Minerals
- Lesson 6.11: Conflicts of Interest
- Lesson 6.12: Soils
- Lesson 6.13: Water

Section V: Oceanography

- Lesson 6.14: Ocean Resources
- Lesson 6.15: Pollution of the Oceans



STUDY GUIDE FOR LEARNING CARREL LESSON

6.15

POLLUTION OF THE OCEANS

ENVIRONMENTAL STUDIES

A Cooperative Project of the Department of
Geological Sciences and the Science Educa-
tion Center

THE UNIVERSITY OF TEXAS AT AUSTIN

TO THE STUDENT:

This booklet contains two sections: (1) the Student Study Guide for this lesson, and (2) the Script or printed copy of the discussion recorded on the audio cassette tape.

You are expected to begin with the printed instructions in the Study Guide and follow them continuously as you study the lesson. In many instances the same or similar instructions may also be heard on the audio cassette tape. Refer to the script only if you need to refresh your memory as to something that was said. The script is provided because you cannot back up the tape if you need to review something already said on the tape.

Specific instructions will be given in the Study Guide as to when to start and stop the tape. Do not restart the tape until instructed to do so in the Study Guide.

Questions requiring written answers should be completed on the STUDENT RESPONSE SHEETS provided by the instructor.



INSTRUCTIONS:

1. Read the Introduction, Rationale, and Objectives for this lesson that follows. If you have questions, check with the Instructor or Proctor.

INTRODUCTION:

Think for a moment about the role the oceans play in the biosphere. How many life forms owe their origin to this enormous mass of water that covers over 70% of the planet's surface? How many people have occupations that are directly or indirectly tied to the oceans? What role will the oceans play in man's future? It is not the biosphere alone that is influenced by the oceans, climate patterns all over the world are affected by the ocean waters. Suppose the ocean is changed through man's use or misuse. What affect will this have on the conflict between man and the laws of nature?

In this lesson we look in some detail on one aspect of the conflict -- man vs. nature -- that man seems to be winning. Natural process cannot handle the materials man adds to the oceans as rapidly as required to keep the oceans from becoming polluted.

RATIONALE:

The developers of this lesson were concerned about the changes man is making in the near shore environments of the oceans. Clearly, this is one of the locations in the oceans where man's activities are most pronounced and easiest to observe. It is the pollution of the near shore environments that have the most direct effect on man — his recreation, his food supply, and his ocean-related occupations. For these reasons, this lesson focuses on the sources and effects of pollution of the oceans.

OBJECTIVES OF THIS LESSON:

At the end of this lesson you should be able to:

1. list five ways the oceans are important to man
2. name the major sources and kind of pollutants man adds to the oceans
3. explain how pollutants harmful to man are concentrated in living organisms
4. describe the effects produced in living organisms, including man, by the materials he adds to the oceans
5. identify the major economic loss that can attribute to man's pollution of the oceans.



INSTRUCTIONS:

2. Start the audio cassette tape and slides. (For manually operated slide carousels, be sure the slide on the screen is the title slide or the blank colored slide in slot number one. Otherwise, the slides and tape will not be synchronized.) Listen to the tape and view the slides until you are told to take the Pretest. Then **STOP THE TAPE AND SLIDES** and complete the Pretest on the white pages at the end of your STUDENT RESPONSE SHEETS. At the end of this lesson you will be asked to take a Posttest on the green pages that match the white pages at the end of your STUDENT RESPONSE SHEETS. You can then compare your answers on the Pretest and Posttest to determine some of the things you learned during this lesson.

INSTRUCTIONS:

3. Restart the audio cassette tape. Listen to the tape and view the slides until you are told to stop the tape and read the Glossary. Then STOP THE TAPE AND SLIDES and study the ideas listed under Frame 1 below.

Frame 1

The first series of slides in this program are related to seven ways the oceans are important to man. Study these ideas and look for them in the lesson.

1. Oceans contribute to the oxygen-carbon dioxide balance in the atmosphere.
2. Oceans affect the global climate.
3. Oceans provide the source of moisture for the world's hydrologic system.
4. Oceans provide food.
5. Oceans provide a habitat for much of our fish and wildlife.
6. Oceans provide chemicals and minerals for man.
7. Oceans provide transportation, recreation, and a pleasant setting for man.

INSTRUCTIONS:

4. Restart the audio cassette tape and slides. Listen to the tape and view the slides until reference is made to Frame 2. Then STOP THE TAPE AND SLIDES.

Frame 2

You have been listening to a report of the major sources and kinds of ocean pollutants. Below is a list of the major sources of pollutants. On your STUDENT RESPONSE SHEET opposite each source, list at least two of the kinds of pollutants produced by that source.

Source

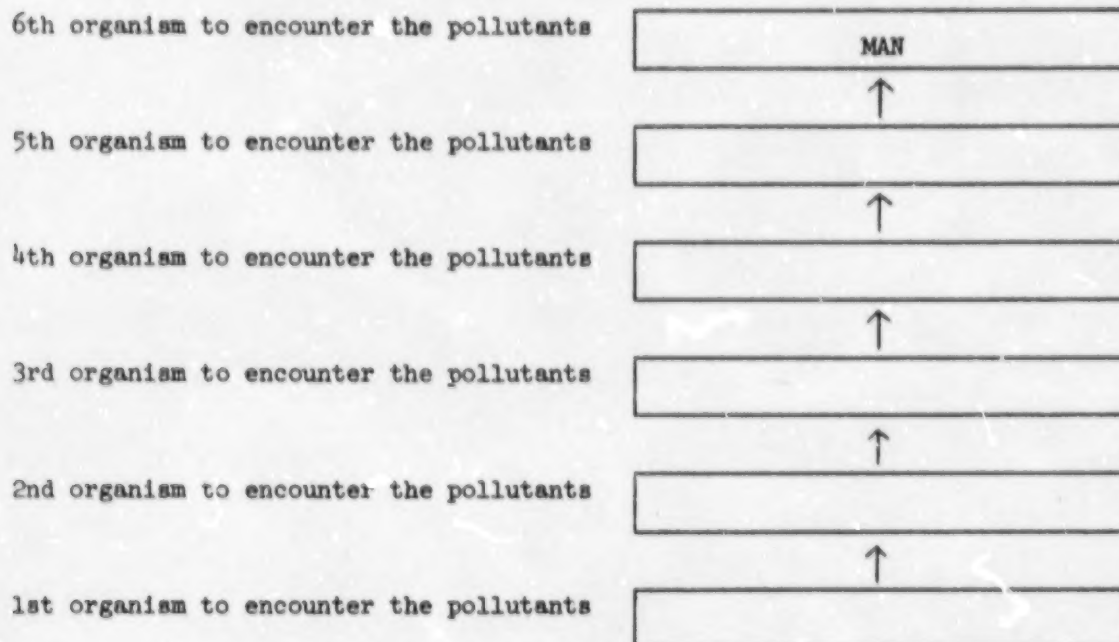
Industrial liquid wastes
 (non-petroleum wastes)
 Municipal solid wastes
 Municipal liquid wastes
 Agricultural pollutants
 Petroleum related wastes
 Air pollutants

➡ INSTRUCTIONS:

5. Restart the audio cassette tape. Listen to the tape and view the slides until reference is made to Frame 3. Then STOP THE TAPE AND SLIDES.

Frame 3

Pollutants that affect marine organisms and thereby ultimately affect man are concentrated in the food chain. In the food chain flow chart on your STUDENT RESPONSE SHEET similar to the one below, you are to fill in the spaces provided with words or phrases that show how the concentration progresses up the food chain. Refer to the script (slide 32) if you cannot complete the food chain correctly.



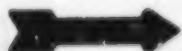
➡ INSTRUCTIONS:

6. Restart the audio cassette tape. Listen to the tape and view the slides until reference is made to Frame 4. Then STOP THE TAPE AND SLIDES.

Frame 4

Pollutants in ocean waters affect the living organisms in several ways. For example, the plants and animals are sometimes killed by toxic wastes. In this frame you will be asked to list the effect of sublethal doses of pollutants on specific organisms. Place your answer in the spaces provided on your STUDENT RESPONSE SHEET. Refer to the script, slides 27 through 39, if you have trouble answering the exercise.

<u>Pollutant</u>	<u>Organism</u>
Mercury	Man
Pesticides	Mollusk Shells
Pesticides Copper	Fish
Pesticides	Birds
Oil	Marine Organisms
Oxygen Depletion	Marine Organisms
Phosphates and Nitrates	Algae
Algae Mud	Clams
Sewage Waste	Sea Urchins
Coliform	Shellfish Beds



INSTRUCTIONS:

7. Restart the audio cassette tape. Listen to the tape and view the slides until the end of the lesson.

ANSWERS TO QUESTIONS IN STUDY GUIDE

FRAME 1 Answers

No answer required.

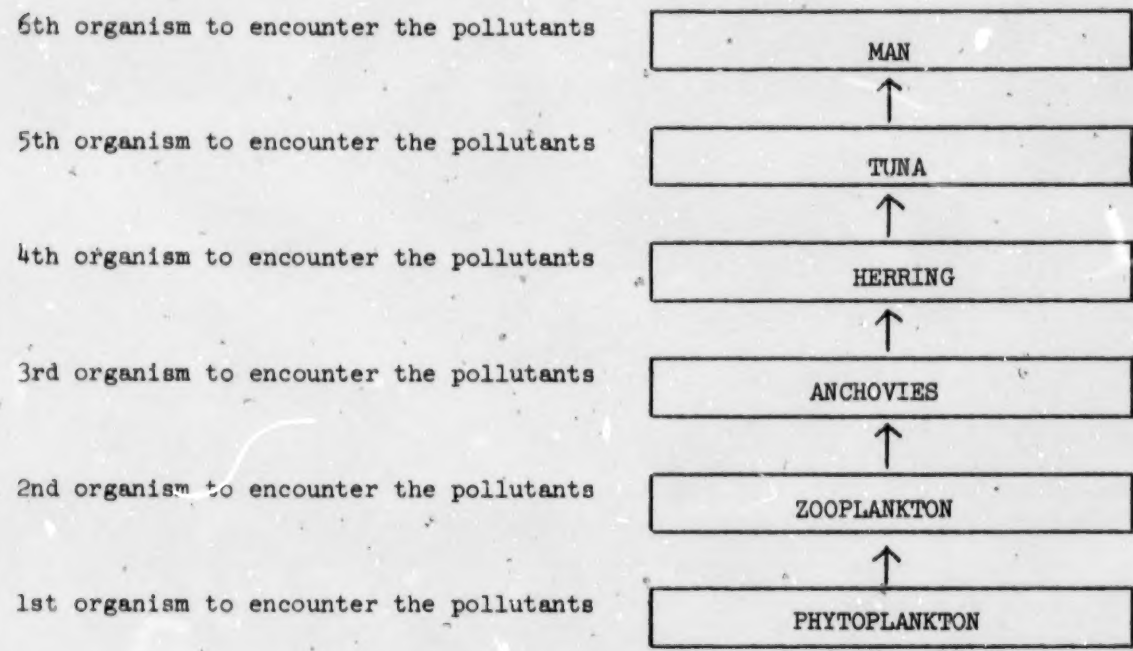
FRAME 2 Answers

You have been listening to a report of the major sources and kinds of ocean pollutants. Below is a list of the major sources of pollutants. Opposite each source list at least two of the kinds of pollutants produced by that source.

<u>Source</u>	<u>Kind of Pollutants</u>
Industrial liquid wastes (non-petroleum wastes)	<u>acids, insecticides,</u> <u>pesticides, herbicides,</u> <u>paper mill wastes</u>
Municipal solid wastes	<u>garbage</u> <u>construction materials</u>
Municipal liquid wastes	<u>detergents</u> <u>sewage</u>
Agricultural pollutants	<u>animal wastes</u> <u>fertilizers</u>
Petroleum related wastes	<u>pipeline breaks</u> <u>tankers run aground</u>
Air pollutants	<u>city odors</u> <u>dust</u>

FRAME 3 Answer

Pollutants that affect marine organisms and thereby ultimately affect man are concentrated in the food chain. In the food chain flow chart below you are to fill in the spaces provided with words or phrases that show how the concentration progresses up the food chain.



FRAME 4 **Answers**

Pollutants in ocean waters affect the living organisms in several ways. For example, the plants and animals are sometimes killed by toxic wastes. In this frame you will be asked to list the effect of sublethal doses of pollutants on specific organisms. Place your answer in the spaces provided below.

<u>Pollutant</u>	<u>Organism</u>	<u>Effect of Pollutants</u>
Mercury	Man	<u>toxic/neurological</u>
Pesticides	Mollusk Shells	<u>reduce size and strength of shells</u>
Pesticides Copper	Fish	<u>reduced growth rate</u>
Pesticides	Birds	<u>damage reproductive capacity</u>
Oil	Marine Organisms	<u>clogs filtering mechanisms</u>
Oxygen Depletion	Marine Organisms	<u>organisms die</u>
Phosphates and Nitrates	Algae	<u>nutrients - biostimulation</u>
Algae Mud	Clams	<u>clams die</u>
Sewage Waste	Sea Urchins	<u>some organisms die, others stimulated</u>
Coliform	Shellfish Beds	<u>evidence of pathogens -- close shell- fish harvesting</u>

ANSWERS TO PRETEST

1. What percent of all marine invertebrates spend the first few weeks of their lives in estuaries?

a. 30%
b. 50%
c. 70%
☒ d. 90%

2. What percent of the U.S. population lives on our coastline?

a. 20%
b. 40%
☒ c. 60%
d. 80%

3. Which of the following is the largest source of marine pollution?

☒ a. industrial liquid wastes
b. agricultural pollutants
c. pesticides
d. sewage

4. Name five sources of marine pollution.

unsanitary landfills, municipal wastes,
barges, ships, or pipelines, agricul-
tural pollutants, industrial wastes,
dredge spoils

5. Through which one of the following do pollutants first enter the marine environment?

a. herring
☒ b. phytoplankton
c. tuna
d. zooplankton

6. In which one of the following do pollutants reach their highest concentrations?

a. birds
b. phytoplankton
☒ c. tuna
d. zooplankton

ANSWERS TO POSTTEST

a. 30%
b. 50%
c. 70%
☒ d. 90%

a. 20%
b. 40%
☒ c. 60%
d. 80%

☒ a. industrial liquid wastes
b. agricultural pollutants
c. pesticides
d. sewage

unsanitary landfills, municipal wastes,
barges, ships, or pipelines, agricul-
tural pollutants, industrial wastes,
dredge spoils

a. herring
☒ b. phytoplankton
c. tuna
d. zooplankton

a. birds
b. phytoplankton
☒ c. tuna
d. zooplankton

ANSWERS TO PRETEST (continued)

7. Explain how marine pollution causes oxygen depletion of the waters.

oxygen depletion is caused by natural processes removing oxygen from the water in decomposition of waste materials

8. In which one of the following areas is an oil spill likely to be most disastrous?

- a. a previously unpolluted coastal area
- b. the open oceans
- ☒ c. a moderately polluted coastal area

9. Fish are dependent on plantlife for both food and oxygen. Why then is biostimulation (the accelerated fertilization of plant life) harmful to marine animals?

biostimulation accelerates plantlife which takes oxygen from the water when the plants are decomposed by natural processes

10. Measurement of which of the following substances is the standard method used to determine the health hazard of water to humans?

- ☒ a. coliform bacteria
- b. mercury
- c. oxygen
- d. salt

11. Name 3 ways in which marine pollution causes economic losses.

changes natural habitats
forces the closing of beaches
chemicals kill commercially valuable fish or seafood species
Makes fish, shrimp, and shellfish unfit for human consumption
Makes unpleasant odors

ANSWERS TO POSTTEST (continued)

oxygen depletion is caused by natural processes removing oxygen from the water in decomposition of waste materials

- a. a previously unpolluted coastal area
- b. the open oceans
- ☒ c. a moderately polluted coastal area

biostimulation accelerates plantlife which takes oxygen from the water when the plants are decomposed by natural processes.

- ☒ a. coliform bacteria
- b. mercury
- c. oxygen
- d. salt

changes natural habitats
forces the closing of beaches
chemicals kill commercially valuable fish or seafood species
makes fish, shrimp, and shellfish unfit for human consumption
makes unpleasant odors

GLOSSARY

bilge water: wastewater from ships dumped at sea

biostimulation: accelerated growth of plant life due to over-fertilization

"black liquor": liquid wastes from paper mills which are highly poisonous to marine organisms

coliform bacteria: a bacteria which lives in vertebrate intestines

dredge spoils: the bottom marine sediment excavated by dredging

estuary: a salt water/freshwater environment where the ocean tides meet the current of a stream

heavy metals: a metal of high specific gravity such as mercury or copper; the term often refers to metals which in compound form are poisonous to organisms.

Heyerdahl: Thor Heyerdahl; a present-day archaeologist and adventurer. One of his exploits has been to retrace the hypothetical voyage of Egyptians to Latin America across the Atlantic Ocean in a papyrus boat.

landing: a fish catch brought from the sea to land

phytoplankton: minute marine plant life

sewage outfall: the vent of a drain or sewer where it drops away into a large body (ocean, river, bay, etc.)

sewage sludge: the waste solid by-product of municipal wastewater treatment processes

solid waste: garbage or trash, up to 50% of which is usually paper, wood, plastics, and rubber

zooplankton: minute marine animals

SCRIPT FOR LEARNING CARREL LESSON

6.15

POLLUTION OF THE OCEANS

ENVIRONMENTAL STUDIES

A Cooperative Project of the Department of
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Center

THE UNIVERSITY OF TEXAS AT AUSTIN

1

Title Slide

2

Pretest
(white pages)

Before you begin this lesson, please take the Pretest on the white pages in your Study Guide. Please stop the tape now.

3

Read definitions
in the Glossary

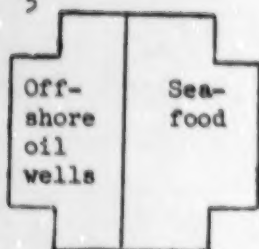
This lesson contains some terms which you may not be familiar with. Therefore, it is imperative that you read the Glossary in your Study Guide before you begin the lesson. Stop the tape now.

4

Deep blue
ocean waters

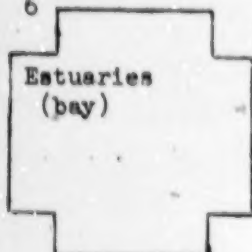
Oceans cover over 70% of the earth. They contribute to the oxygen-carbon dioxide balance in the atmosphere, affect global climate, and provide the source for the world's hydrologic system.

5



Oceans are economically valuable to man, providing among other necessities, food and minerals.

6



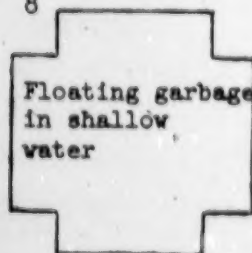
Ocean coastlines are the habitat for much of our fish and wildlife. Estuaries on our shorelines create a delicate saltwater-freshwater environment where 90% of marine invertebrates and many marine fish spend the first few weeks of their life.

7



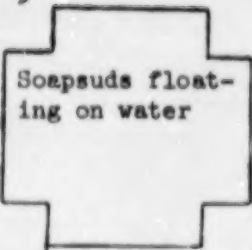
They also provide transportation, recreation, and a pleasant setting for more than 60% of the nation's population.

8



These coastal waters are also the final receptacle for many of our wastes. Essentially, everything we do to our earth eventually pollutes the ocean.

9



Soapsuds float-
ing on water

Pollution from unsanitary landfills, beer cans, sewage, all eventually reach the oceans and have their effect.

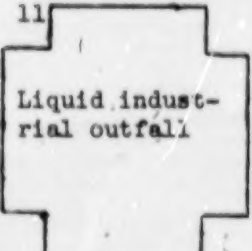
10



Industrial or
sewage outfall

There are, however, more direct kinds of pollution which reach the ocean via barge, ship, or pipeline. These are even more harmful because of the concentrations involved.

11



Liquid indust-
rial outfall

Industrial liquid wastes which are the largest source of pollution in coastal and estuarine regions include acids, pesticides, wastes from refineries and paper mills, and other assorted liquids. These wastes are pumped directly into bays and the oceans,

12

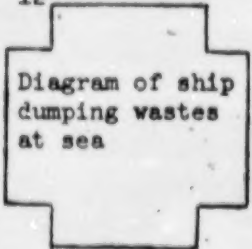
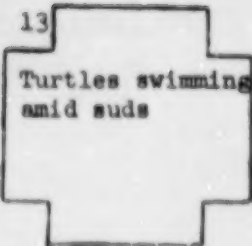


Diagram of ship
dumping wastes
at sea

or hauled out to deeper waters and dumped. Many of these are highly toxic, including cyanides, arsenic and mercuric compounds, heavy metals, and "black liquor" from pulp and paper mill wastes.

13



Turtles swimming
amid suds

Municipal liquid wastes, including sewage and solid wastes, are the second largest source of pollution.

14



Scum and float-
ing garbage

Up to 50% of solid wastes, or garbage, is usually paper, wood, plastics, and rubber, all of which can float to the surface and can be transported greater distances by current and wind.

15



Heyerdahl
expedition

Early in 1970, the Heyerdahl expedition encountered wastes over large areas of water in mid-ocean, reporting that the ocean was "visibly polluted by human activity."

16



Crop dusters

Agricultural pollutants from land runoff, animal wastes, pesticides, and fertilizers add to the load of wastes ultimately reaching the ocean.

17



Dredge at work

Dredge spoils are the solid materials removed from the bottom of water bodies generally for the purpose of improving navigation. About 34% of this material is polluted.

18



Heavy industry
polluting air

This contamination comes from industrial, municipal, and agricultural pollutants which have been deposited on the bottom of bays and coastal shores.

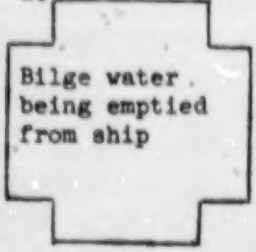
19



Sewage sludge
agitator

Another pollutant is sewage sludge which is the waste solid by-product of municipal wastewater treatment processes. Sewage sludge contains heavy metals, oxygen-demanding materials, including residual human wastes, and some disease-causing bacteria.

20



Bilge water
being emptied
from ship

Bilge water from ships, filled with oil and wastes from ship engines are emptied directly into the ocean, both in harbors and on the high seas.

21



Aerial view of
oil spill near
refinery

Many accidents occur in offshore oil drilling areas. Pipelines break, wells blow out, oil tankers run aground, and oil is spilled in transfer from storage stations to tankers.

22



Finger dipped
in water, and
coming out
covered in oil

All too often the surrounding waters wind up looking like this.

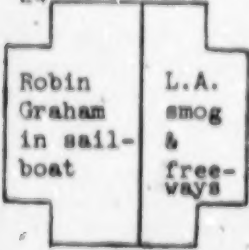
23



Air-polluting
smokestacks

A large part of air pollutants eventually end up in the ocean -- directly, or through runoff from the land.

24



Robin
Graham
in sail-
boat

L.A.
smog
&
free-
ways

Robin Graham, the young man who sailed around the world alone in a sailboat, reported that he could smell Los Angeles one hundred miles out to sea. It smelled like "wet concrete."

25

Stop the tape
now.

Frame 2

26

Cartoon: Man
cutting into
fish & getting
squirted with
oil

In order to understand the effects of pollutants on marine ecosystems, one needs to understand how pollutants are dispersed and concentrated.

27

Phytoplankton

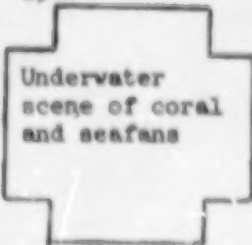
Pollutants enter living systems through biological concentration. Billions of tiny phytoplankton organisms act as a great biological blotter, picking up nutrients, trace metals, and other materials.

28

Shellfish

Heavy metals have been found in toxic concentrations in plankton, seaweed, and shellfish, although levels of concentration in the surrounding water were not high.

29



Underwater scene of coral and seafans

The ability of biota to concentrate materials varies from a few hundred to several hundred thousand times the concentrations in the surrounding environment.

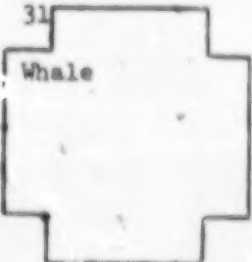
30



Fish nibbling plants

Organisms feed on the phytoplankton and successively pass the pollutants on to higher organisms.

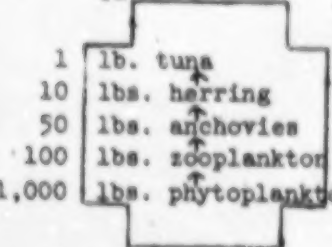
31



Whale

As this process moves through the food chain, concentrations reach their highest levels in predators such as marine mammals, birds, and man.

32



1 lb. tuna
10 lbs. herring
50 lbs. anchovies
100 lbs. zooplankton
1,000 lbs. phytoplankton

For example, 1,000 pounds of phytoplankton produces 100 pounds of zooplankton, which produces 50 pounds of anchovies, which produce 10 pounds of herring, which produce 1 pound of tuna.

33

Stop the tape
now

Frame 3

34

diatoms

fish
on
ship-
deck

1 oz. mercury

If these 1,000 pounds of phytoplankton had assimilated 1 ounce of mercury from surrounding water, the same one ounce of mercury would be found in the 1 pound of tuna harvested by fishermen.

35

Japanese
fishermen

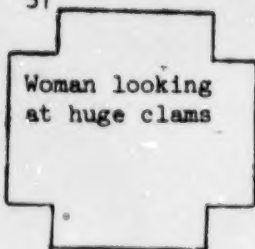
Between 1953 and 1960, one hundred and eleven persons were reported to have been killed or to have suffered serious neurological damage near Minamata, Japan, as a result of eating fish and shellfish caught in areas contaminated by mercury.

36

Deformed
children

Among these were 19 congenitally defective babies whose mothers had eaten the fish and shellfish.

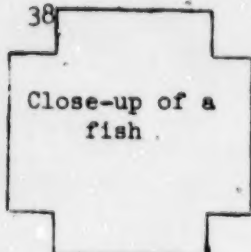
37



Woman looking
at huge clams

Although plants and animals are sometimes killed by toxic wastes, organisms may be affected by concentrations far below the lethal level. For example, sublethal doses of pesticides reduce the size and strength of mollusk shells.

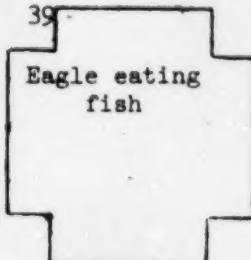
38



Close-up of a
fish

Fish exposed to sublethal doses of pesticides and copper have also exhibited reduced growth rate and reproductive activity.

39



Eagle eating
fish

Pesticides endanger higher predators because of biological concentration. For example, pesticides amplified through the food chain damage birds' reproductive capability, and in some cases seriously reduce their populations.

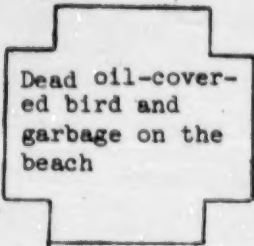
40



Oil covered
live bird on
beach

Oil introduced into the marine environment alters reproduction and other behavior.

41



Dead oil-covered
bird and
garbage on the
beach

Direct contact with respiratory organs weakens or kills animals, and oil clogs their filtering mechanisms.

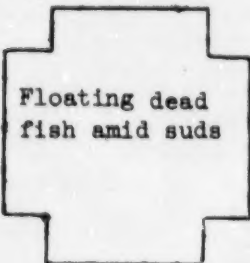
42



Sewage outfall

Pollution can also cause oxygen depletion. Oxygen supports marine and aquatic life and is necessary for the biological degradation of organic materials.

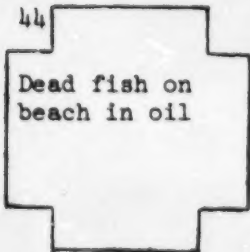
43



Floating dead
fish amid suds

Organic wastes dumped or discharged into water bodies require oxygen to decompose. If waste loads are too heavy, the oxygen levels become depleted, and the diversity of marine organisms is altered.

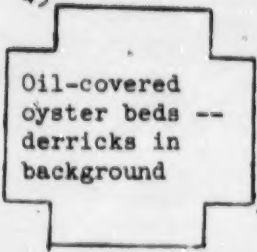
44



Dead fish on
beach in oil

For example, large amounts of oxygen are required to decompose oil. If the oxygen level is already low in an oil spill area, damage from the oil spill may be even more severe.

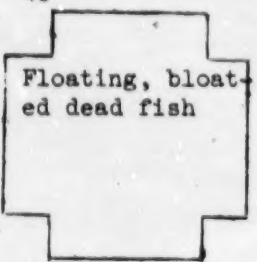
45



Oil-covered
oyster beds --
derricks in
background

Many of the nation's rivers, estuaries, and harbors are in this condition. In the Potomac estuary, severely polluted by municipal wastes, dissolved oxygen levels approach zero in some areas during warm summer months.

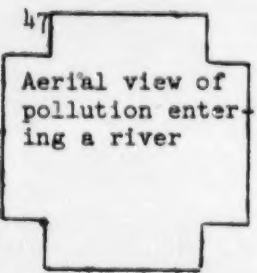
46



Floating, bloated
dead fish

When all oxygen is depleted, organisms die, and anaerobic bacteria produce malodorous gases.

47



Aerial view of
pollution enter-
ing a river

Some wastes, such as sewage sludge, are particularly rich in nutrients such as phosphates and nitrates.

48



Algal bloom

These nutrients can cause biostimulation -- the accelerated fertilization of plant life. When these plants die, oxygen necessary to support marine life is used in their decomposition.

Another algal
bloom

And when dead algae are carried to beaches, they rot and produce unpleasant odors. By creating excessive blooms of algae, biostimulation indirectly changes the nature of bottom sediments,

50

Seafloor scene

and thus the whole community of bottom organisms. For example, areas which formerly supported surf clams in sand may become covered with an algal mud to which the surf clams cannot adapt. Changes in the kinds and quantities of sediments deposited may alter ecosystems.

51

Crown of Thorns
starfish

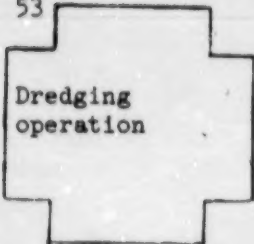
The plague of starfish in the Pacific may be an example of this effect. In recent years, the numbers of Crown of Thorns starfish have multiplied.

52

Crown of
Thorns star-
fish eating
coral

This coral-eating starfish has devastated large areas of the coral reefs off many Pacific islands and the Great Barrier Reef of Australia.

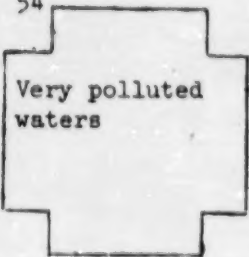
53



Dredging
operation

The starfish population explosion may be linked to sediment from blasting, dredging, and dumping, which protect the larval starfish from their predators.

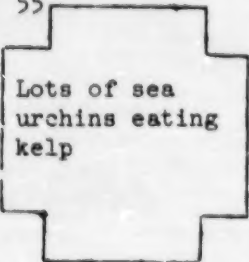
54



Very polluted
waters

Another example of habitat change due to pollution is along the Southern California coast. Significant changes in the benthic ecology have been caused by sewage wastes from several municipalities.

55



Lots of sea
urchins eating
kelp

These wastes brought about a shift in the marine population. Large numbers of sea urchins replaced other organisms and grazed on giant kelp beds near the sewage outfalls.

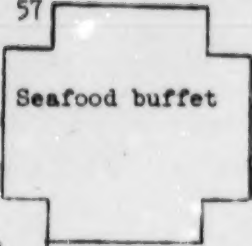
56



Diver amid kelp

Because of the commercial value of giant kelp and the habitat it provides for many marine animals, the changes were an economic and an ecologic loss.

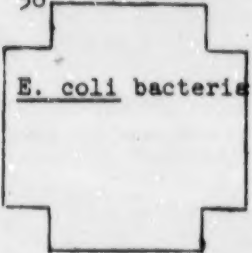
57



Seafood buffet

Public health problems are created by toxic agents and pathogens that find their way into the human food chain through seafood.

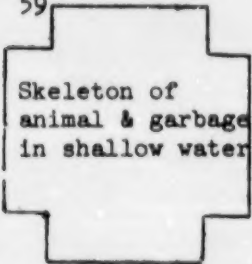
58



E. coli bacteria

The standard method for determining the potential public health hazard of fish is the coliform bacteria count. These harmless bacteria are rough indicators of pathogens. If the count exceeds Food and Drug Administration standards, shellfish beds are closed to harvesting.

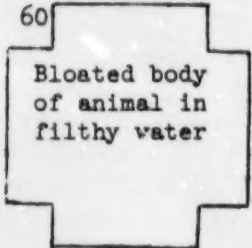
59



Skeleton of animal & garbage in shallow water

Many beaches have also been closed to swimming because of the high coliform content of the water. Most closed beaches are near large metropolitan areas, such as San Francisco and New York.

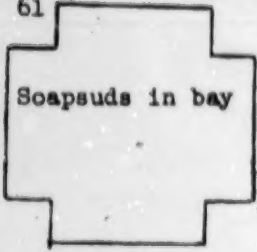
60



Bloated body of animal in filthy water

Floating materials, such as solid wastes and oil, pose a major threat to amenity values.

61



Seapsuds in bay

Rotting algae and anaerobic waters cause unpleasant odors and visual pollution, and debris is often a hazard to small boats.

62



Stop the tape
now.

Frame 4

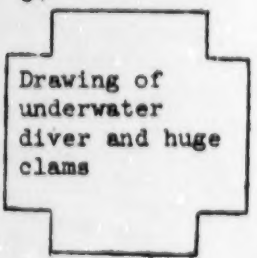
63



Floating dead
fish

Significant economic losses result from ocean pollution. A major loss is the commercially valuable fish or other seafood species killed directly or indirectly, or rendered inedible.

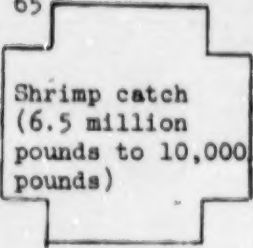
64



Drawing of
underwater
diver and huge
clams

Prior to 1935, the annual commercial catch of soft shell clams in San Francisco Bay was between 100,000 and 300,000 pounds. Today, clam digging is virtually nonexistent because of pollution.

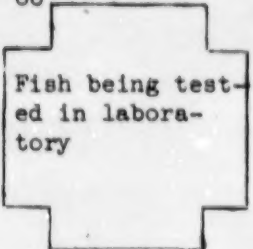
65



Shrimp catch
(6.5 million
pounds to 10,000
pounds)

The annual commercial landings of the shrimp fishery prior to 1936 were as high as 6.5 million pounds; landings in 1965 were only 10,000 pounds.

66



Fish being test-
ed in labora-
tory

Contamination by pesticides or mercury has rendered nine species of fish unfit for consumption by humans. Some states have impounded fish and banned fishing of those species because of mercury poisoning,

67



Head of a coho
salmon

and the FDA impounded coho salmon due to high levels of DDT. Even where contaminant levels do not prevent safe consumption, the food may be discolored or tainted.

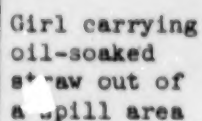
68



Surfer and his
board covered in
oil

Tourist coastal areas are stricken financially by oil spills which reach their beaches. Oily or odorous beaches generally mean no tourists.

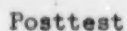
69



Girl carrying
oil-soaked
straw out of
a spill area

A further ocean pollution cost is that of cleaning up or rehabilitating polluted beaches and other shores.

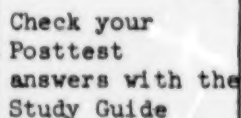
70



Posttest

Now turn in your Study Guide to the Posttest. Answer the test questions again, this time on the green pages. Stop the tape now.

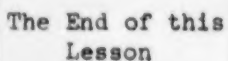
71



Check your
Posttest
answers with the
Study Guide

You may now check your Posttest answers against the answer sheet in the back of your Study Guide. If, after checking, you feel you have learned all you need to know from this lesson, you may stop. However, if you did not answer most of the questions correctly, feel free to take this lesson over again. The Proctor will help you.

72



The End of this
Lesson

LESSON 6.15: POLLUTION OF THE OCEANS

STUDENT RESPONSE SHEETS

Name _____

Date _____

LESSON 6.15: POLLUTION OF THE OCEANS

STUDENT RESPONSE SHEET

Frame 1

No answers required

Frame 2

You have been listening to a report of the major sources and kinds of ocean pollutants. Below is a list of the major sources of pollutants. Opposite each source list at least two of the kinds of pollutants produced by that source.

Industrial liquid wastes
(non-petroleum wastes)

Municipal solid wastes

Municipal liquid wastes

Agricultural pollutants

Petroleum related wastes

Air pollutants

Name _____

Date _____

LESSON 6.15: POLLUTION OF THE OCEANS

STUDENT RESPONSE SHEET

Frame 3

Pollutants that affect marine organisms and thereby ultimately affect man are concentrated in the food chain. In the food chain chart below, you are to fill in the spaces provided with words or phrases that show how the concentration progresses up the food chain.

6th organism to encounter the pollutants

MAN



5th organism to encounter the pollutants



4th organism to encounter the pollutants



3rd organism to encounter the pollutants



2nd organism to encounter the pollutants



1st organism to encounter the pollutants

Name _____

Date _____

LESSON 6.15: POLLUTION OF THE OCEANS

STUDENT RESPONSE SHEET

Frame 4

Pollutants in ocean waters affect the living organisms in several ways. For example, the plants and animals are sometimes killed by toxic wastes. In this frame you will be asked to list the effect of sublethal doses of pollutants on specific organisms. Place your answer in the spaces provided.

<u>Pollutant</u>	<u>Organism</u>	<u>Effect of Pollutants</u>
Mercury	Man	_____
Pesticides	Mollusk Shells	_____
Pesticides Copper	Fish	_____
Pesticides	Birds	_____
Oil	Marine Organisms	_____
Oxygen Depletion	Marine Organisms	_____
Phosphates and Nitrates	Algae	_____
Algae Mud	Clams	_____
Sevage Waste	Sea Urchina	_____
Coliform	Shellfish	_____

Name _____

Date _____

LESSON 6.15: POLLUTION OF THE OCEANS
STUDENT RESPONSE SHEET
PRETEST

1. What percent of all marine invertebrates spend the first few days of their lives in estuaries?
 - a. 30%
 - b. 50%
 - c. 70%
 - d. 90%
2. What percent of the U.S. population lives on our coastline?
 - a. 20%
 - b. 40%
 - c. 60%
 - d. 80%
3. Which of the following is the largest source of marine pollution?
 - a. industrial liquid wastes
 - b. agricultural pollutants
 - c. pesticides
 - d. sewage
4. Name five sources of marine pollution.
_____, _____,
_____, _____,
_____, _____
5. Through which one of the following do pollutants first enter the marine environment?
 - a. herring
 - b. phytoplankton
 - c. tuna
 - d. zooplankton
6. In which one of the following do pollutants reach their highest concentrations?
 - a. birds
 - b. phytoplankton
 - c. tuna
 - d. zooplankton

Name _____

Date _____

LESSON 6.15: POLLUTION OF THE OCEANS
STUDENT RESPONSE SHEET
POSTTEST

- a. 30%
 - b. 50%
 - c. 70%
 - d. 90%
-
- a. 20%
 - b. 40%
 - c. 60%
 - d. 80%
-
- a. industrial liquid wastes
 - b. agricultural pollutants
 - c. pesticides
 - d. sewage
-
- _____, _____,
_____, _____,
_____, _____
-
- a. herring
 - b. phytoplankton
 - c. tuna
 - d. zooplankton
-
-
- a. birds
 - b. phytoplankton
 - c. tuna
 - d. zooplankton

Name _____

Date _____

LESSON 6.15: POLLUTION OF THE OCEANS
STUDENT RESPONSE SHEET
PRETEST (continued)

7. Explain how marine pollution causes oxygen depletion of the waters.

8. In which one of the following areas is an oil spill likely to be most disastrous?

- a. a previously unpolluted coastal area
- b. the open oceans
- c. a moderately polluted coastal area

9. Fish are dependent upon plantlife for both food and oxygen. Why then is biostimulation (the accelerated fertilization of plant life) harmful to marine animals?

10. Measurement of which of the following substances is the standard method used to determine the health hazard of water to humans?

- a. coliform count
- b. mercury
- c. oxygen
- d. salt

11. Name 3 ways in which marine pollution causes economic losses.

Name _____

Date _____

LESSON 6.15: POLLUTION OF THE OCEANS
STUDENT RESPONSE SHEET
POSTTEST (continued)

- a. a previously unpolluted coastal area
- b. the open oceans
- c. a moderately polluted coastal area

- a. coliform count
- b. mercury
- c. oxygen
- d. salt

